



# Acute Hemodynamic Effects of Bracelet-M device on the International Space Station

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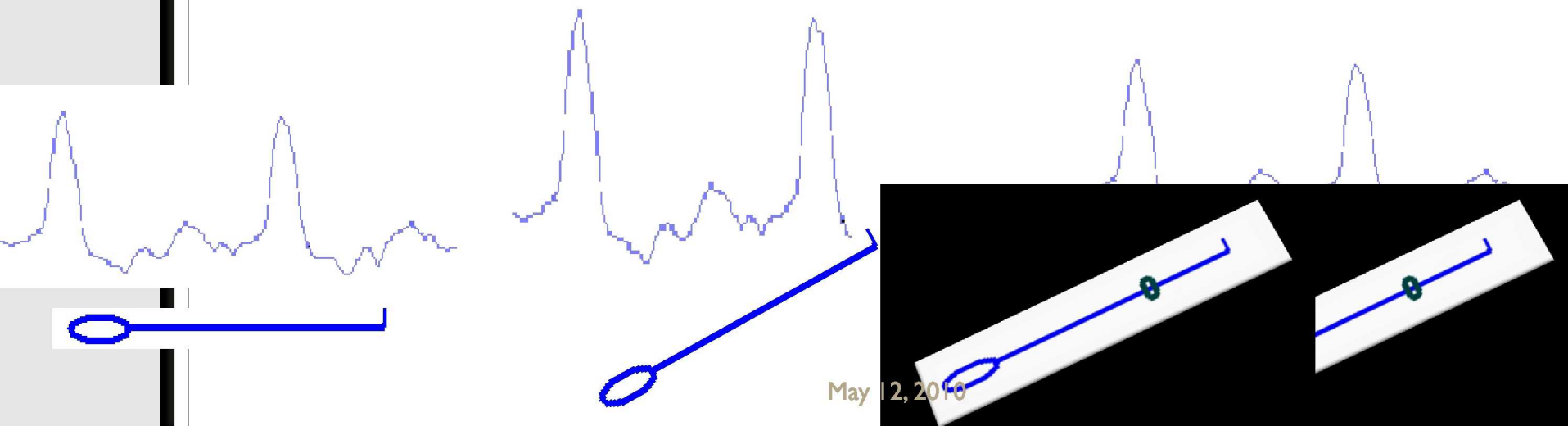


# Background

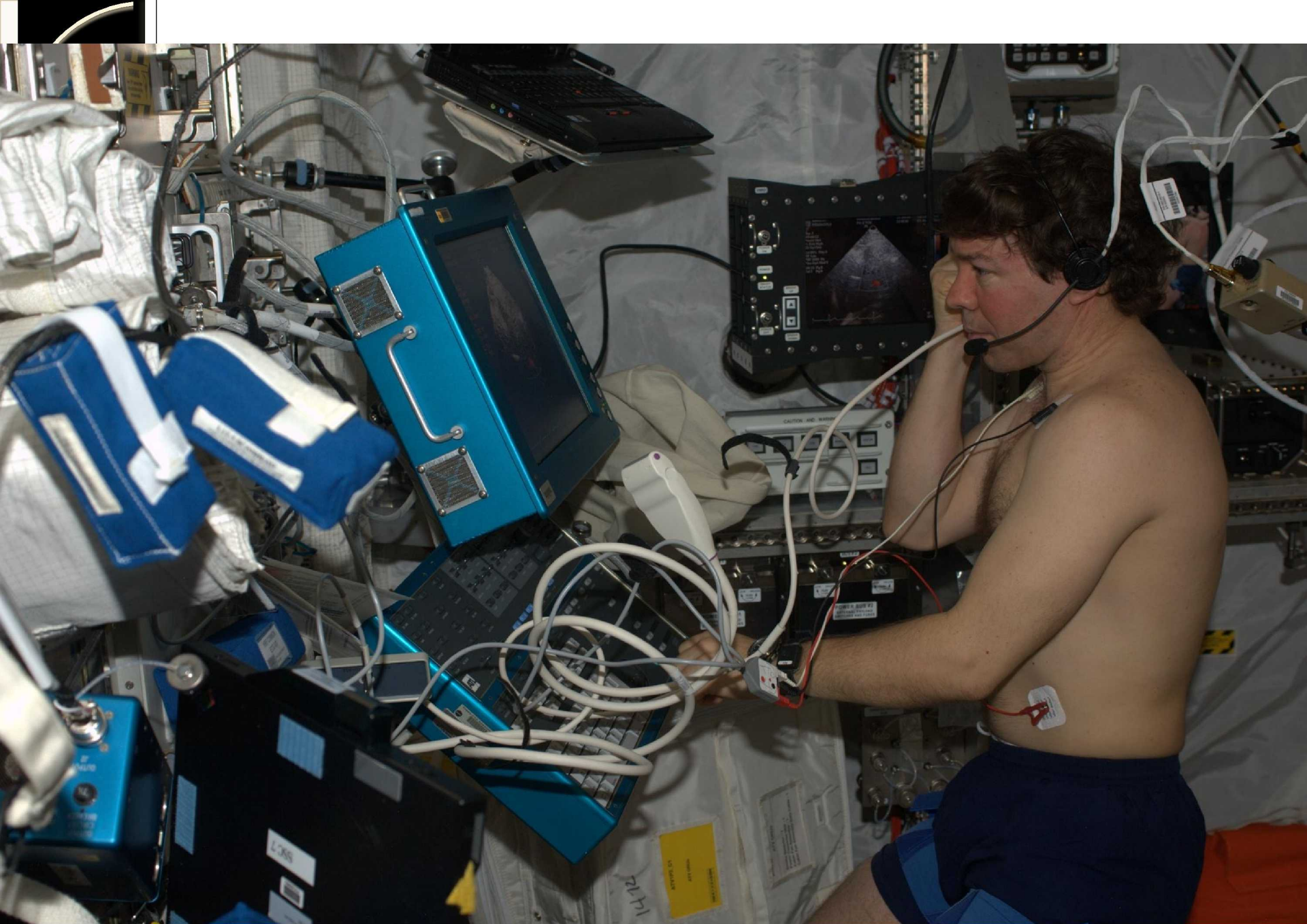
- The Braslet-M is a Russian countermeasure device
- A set of custom-designed elastic/ridged straps that fit tightly around the upper thighs
- Medical prevention strategy that reduces fluid shifts in microgravity in long-duration crew
- Symptoms relieved early microgravity exposure:
  - pulsations in head, nasal congestion, painful eye movement, vestibular disorders, nausea & vomiting
  - Improved cognitive capacity

# Background

- The tightness setting is prescribed
  - Custom fitted and adjusted settings for the individual using subjective feedback
- *Cerebral Rheography=Impedance Plethysmography*








May 12, 2010

# Результаты тарировки

Показатели	Горизон- тальное положение оператора	Положение оператора в антиортостазе 30° <i>Negative 30 degree Head Down Tilt</i>							
		Рабочие зоны на затяжном ремне							
<i>Bracelet Setting</i>	0°	0	1	2	3	4	5	6*	.0
Показа- ПИ	262	305		245	252	250			300
тели А	162	159		42	90	48			133
РЭГ К	149	243		117	99	89			245
ППКГ	99.7	138		75	69	63			133
Выраженность внешних при- знаков		Не видно							
Самочувствие оператора		Хорошо							

\*Примечание. Для изделия "Браслет".



- 
- Subjective measures define the custom fitting and prescription
  - Subsequent microgravity physiology changes that compound the setting:
    - Leg size reduces
    - Lower-extremity interstitial tissue extracellular water decreases
    - Reduce fluid-volume muscle volume



# Mechanism

- Creates a venous hydrostatic pressure that is more similar to the IG environment
- Reduce effective circulation



# ISS Experience

- Crew remotely guided ultrasound experiment looking at a small subset of cardiac and peripheral vascular changes before and after application of Braslet-M
- Primary objectives and secondary objectives
- Review some interesting changes indicating bracelets do reduce preload in microgravity





# Ultrasound parameters

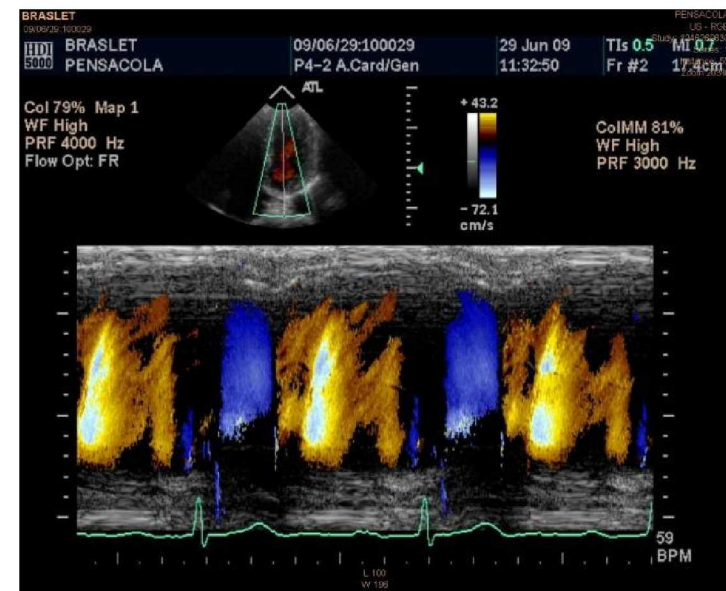
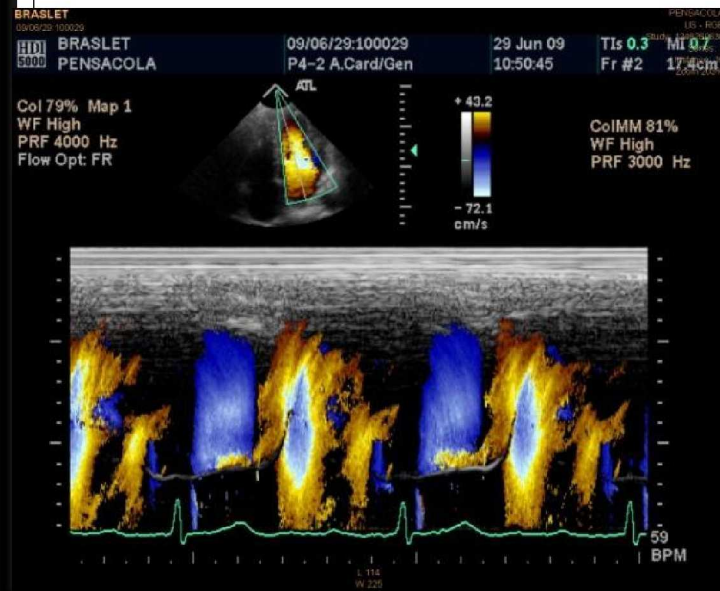
- The femoral vein
  - Cross-section area before and after Braslet-M
- The femoral artery
  - Blood flow before and after Braslet-M
- Left ventricular in-flow pattern
  - Color M-Mode before and after Braslet-M

# Color M-Mode

- Graphic representation of blood flow through the mitral valve into the left ventricle: slope of the first aliasing velocity

Slope w/o Braslet=56ms

Slope w Braslet=42ms



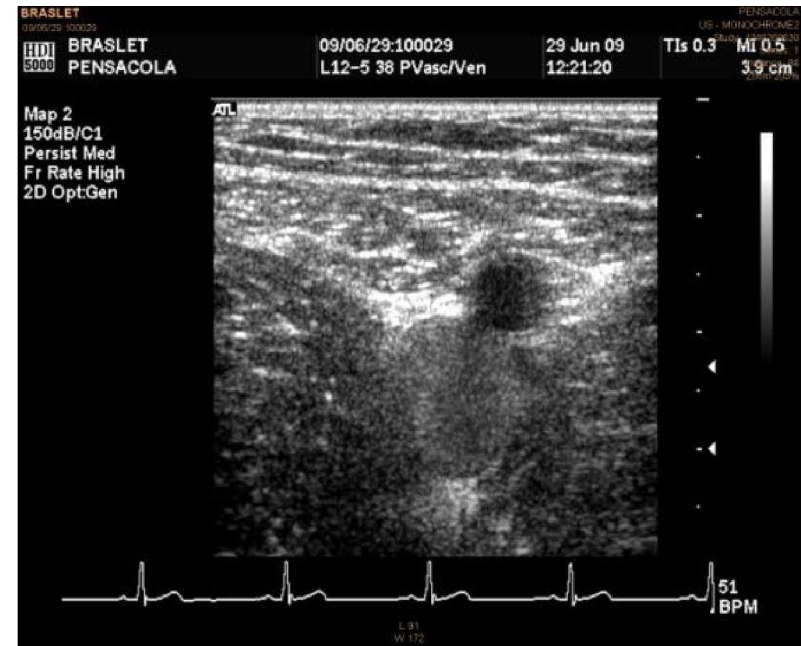
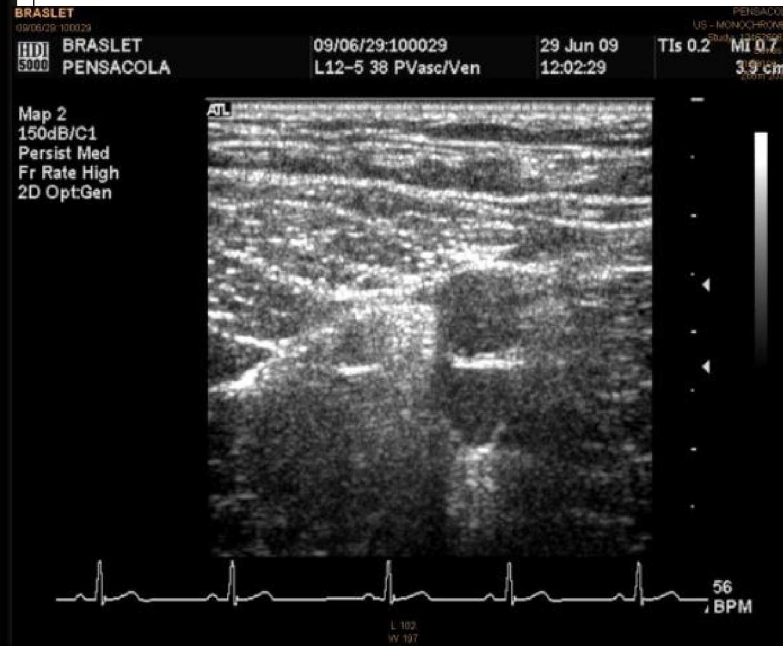
# Femoral Blood Flow

- Doppler arterial blood flow
- After Braslet peak velocity decreased, time integral increased, resistivity and pulsatility increased, no significant change in HR



# Femoral Vein Crossection

- 300% increase in crossection area
- Roleaux formation: stacking of red blood cells increased spectral reflection seen on US





ATL

7C1  
Med  
e High  
t:Gen



# Preliminary Ground example

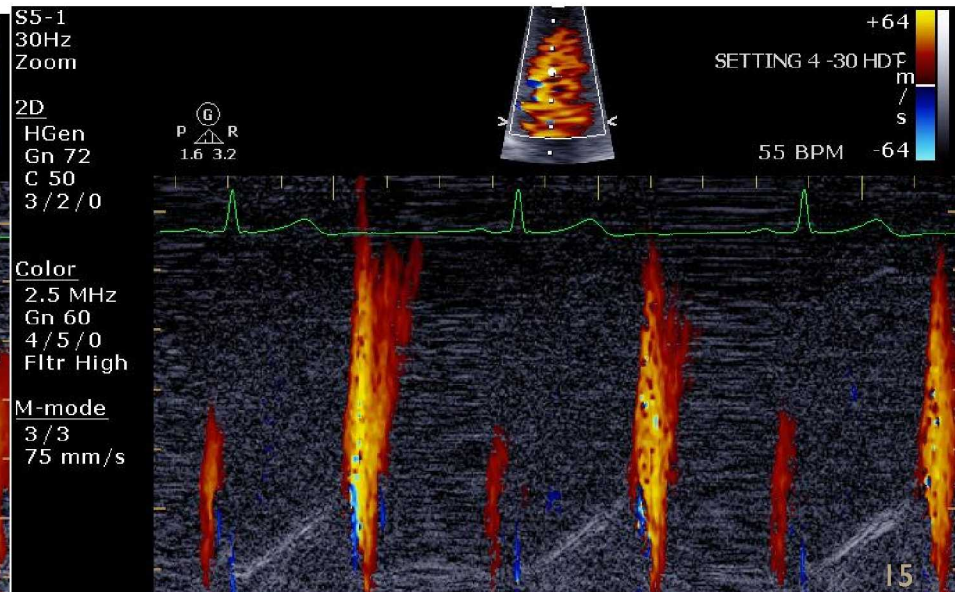
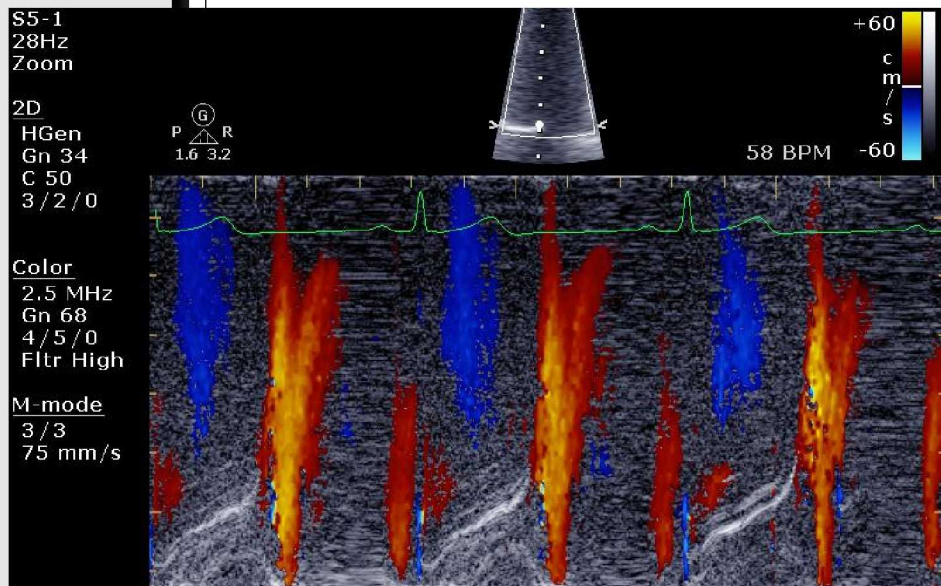
- **Baseline**
  - -30 HDT
- **Braslet @ I**
  - -30 HDT
- **Braslet @ 4**
  - -30 HDT



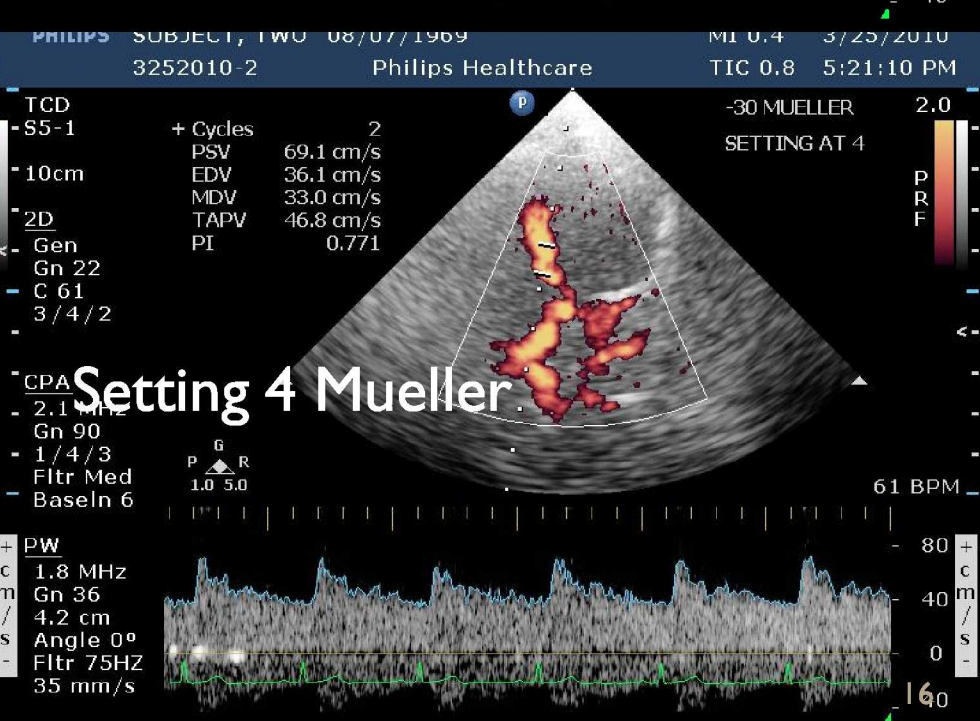
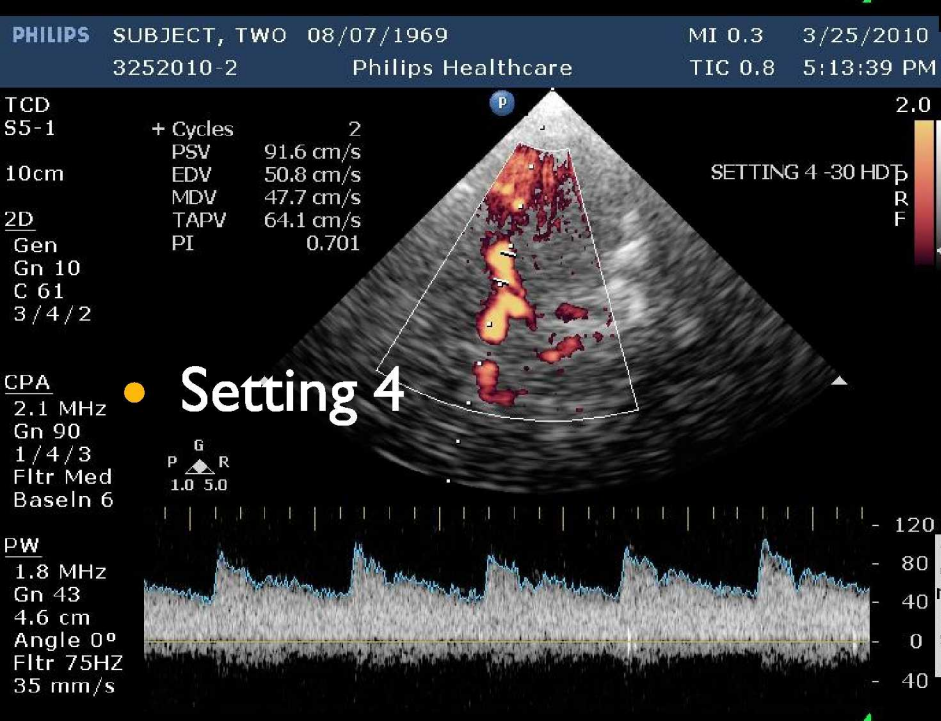
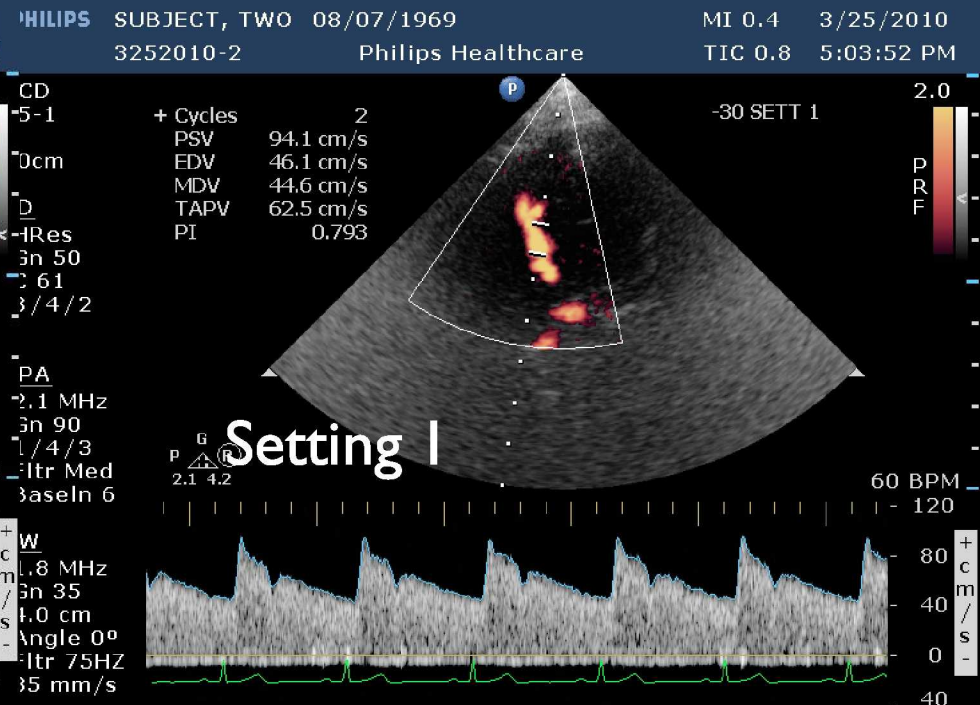
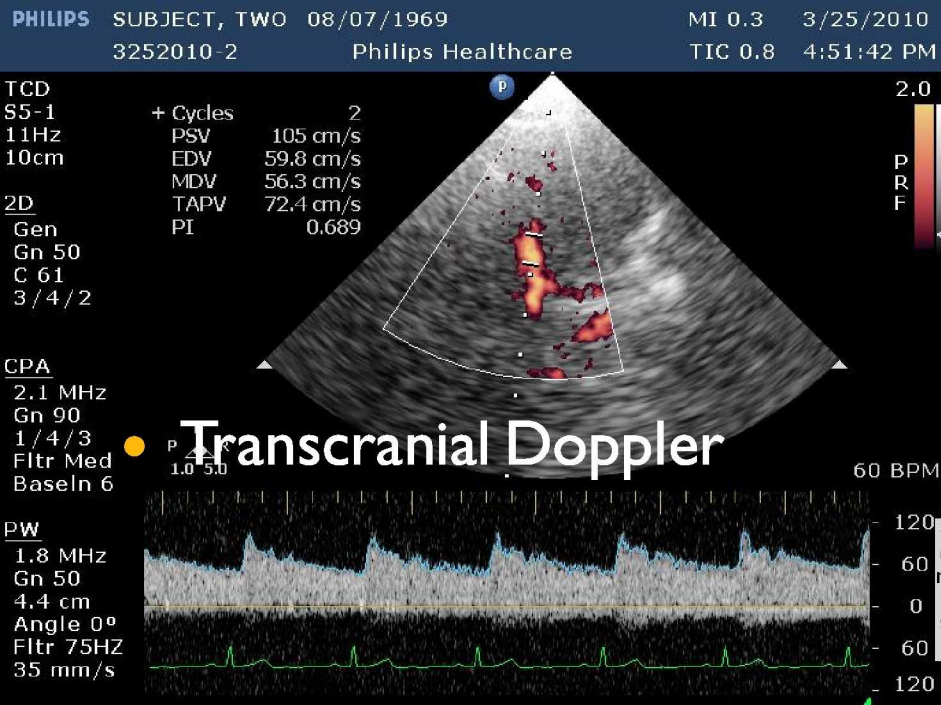
# Preliminary Ground Example

- Baseline
  - -30 HDT
  - Slope 64ms

- Braslet @ 4
  - -30 HDT
  - 70ms









# Pre Release Vein under pressure

PHILIPS TWO 08/07/1969

MI 1.2 3/25/2010

SUBJECT

Philips Healthcare

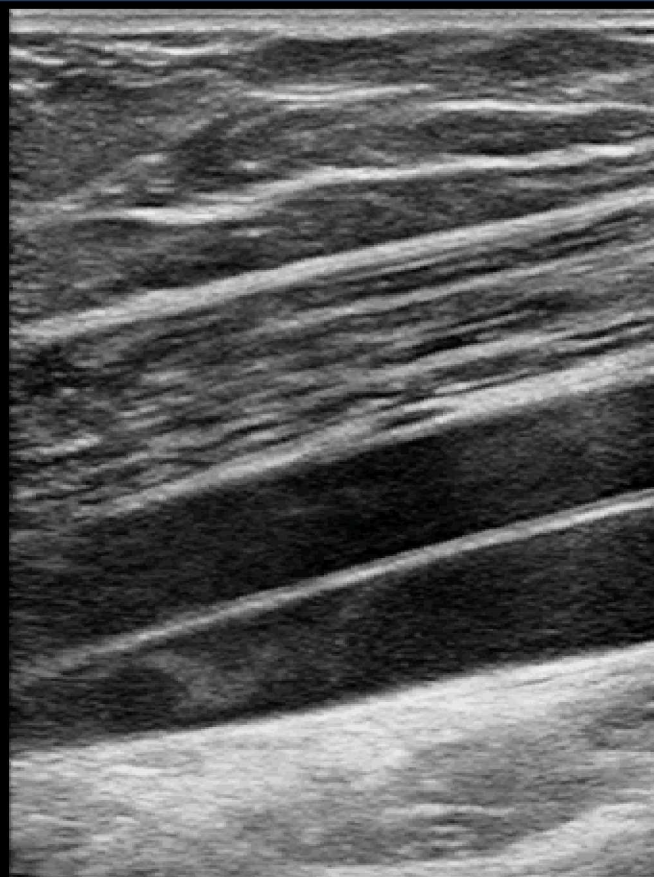
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Venous  
L12-3  
19Hz  
5cm

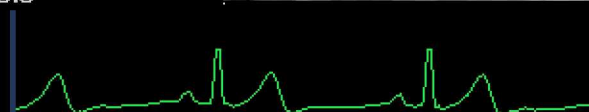
P

2D  
HGen  
Gn 72  
C 41  
3/3/2  
35 mm/s

SETTING4  
30  
MUELLER



G  
P R  
4.4 8.8



56  
BPM

# Release monitoring images

PHILIPS TWO 08/07/1969

MI 1.2 3/25/2010

SUBJECT

Philips Healthcare

TIS 0.2 5:25:14 PM

Venous  
L12-3  
19Hz  
5cm

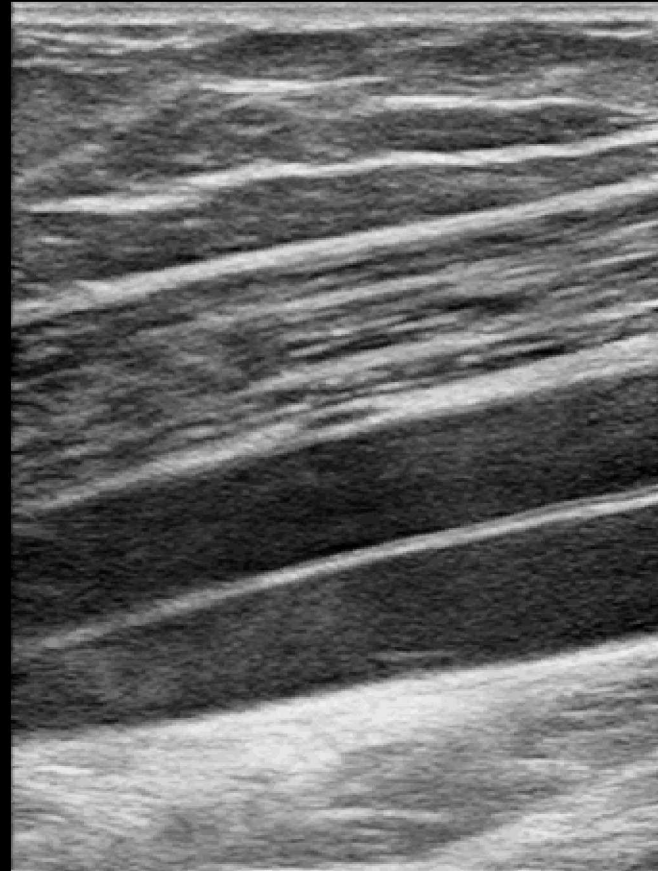
P

2D

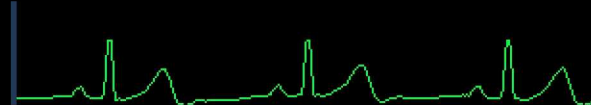
HGen  
Gn 78  
C 41  
3/3/2  
35 mm/s

SETTING4  
30

MUELLER



G  
P R  
4.4 8.8



58  
BPM



## Conclusion

- Increasing the venous pressure in the lower extremities causes the corresponding artery to respond in a hyperemia
- The safety of the therapeutic range is being investigated in this ground study